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of this result led men like Jacobi and Hermite to make efforts to prove a similar theorem with respect to algebraic numbers of the third degree but their efforts were not crowned with success. Comparatively little progress has been made towards useful criteria to determine the degree of algebraic numbers, or even towards determining whether a given number is algebraic or transcendental. One of the problems suggested by Hilbert at the International Congress of Mathematicians held at Paris in 1900 is to determine whether a^p, the base being algebraic and the exponent an irrational algebraic number, always represents a transcendental or at least an irrational number.

It should not be inferred that the preceding problems are suggested as very suitable fields for the young investigator. The main object in stating them is to point out to those who may not have good library facilities that some problems relating to very elementary matters still remain unsolved, and, if possible, to encourage some one to acquaint himself with congeniel fields of study where much remains to be done. A clear understanding of the real nature of unsolved historic problems is of great importance to the stvdent since results bearing on such problems are of especial interest. Many problems of this kind are noted from time to time in *L' Intermediaire des Mathêmaticiens* published by Gauthier-Villars, and a set of about twenty very fundamental ones were given by Hilbert at the Congress mentioned in the preceding paragraph. These have been published in the *Bulletin of the American Mathematical Society*, Vol. 8 (1902), p. 437.

NOTE ON A RECENT PROBLEM IN THE AMERICAN MATHEMATICAL MONTHLY.

By **R. D. CARMICHAEL**, Anniston, Alabama.

The object of this note is to state in a somewhat more general form a proposition in number theory demonstrated on pages 155-156 of Volume XIII of the MONTHLY.

Given that $P^{\delta a}-R^{\delta a}$ *is divisible by* δa, *the necessary and sufficient conditions that the expression* $\frac{P^a - R^a}{\delta a(P-R)}$ *shall be integral are:* (1) a *must be divisible by* e, *the least integer such that* P^e-R^e *is divisible by* a_k, *where for* a_k *is taken in turn the various prime factors of* a *not dividing* $P-R$; (2) δ *is any divisor of* $(P^a - R^a)/a(P-R)$.

The proof is practically identical with that given in the MONTHLY (*l. c.*), except in showing that δ and $I-R$ have no common factor. If δ_1 is such a prime factor, it becomes necessary in the present case to modify the proof that δ_1 must be a factor of a. This is shown as follows:

If δ_1 is contained in $P-R$, then $P=R+\delta_1 n\lambda$, where λ i some integer and $n \overset{=}{>} 1$. Hence,

$$P^{\delta_1}=R^{\delta_1}+\delta_1^{\,n+1}\lambda+\ldots\equiv R^{\delta_1} \pmod{\delta_1^{\,n+1}}.$$

Hence, $P^{\delta_1}-R^{\delta_1}$ is divisible by $\delta_1^{\,n+1}$. But $P^{a}-R^{a}$ is divisible by $\delta_1^{\,n+1}$. Now $P^{\delta_1}-R^{\delta_1}$ is the lowest number of this form which is divisible by $\delta_1^{\,n+1}$. Hence δ_1 is a factor of a.

DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

273. Proposed by THEODORE L. DE LAND, Treasury Department, Washington, D. C.

Three ingots of the precious metals were received at the Mint for assay, where it was found as follows: That in 3 grains of the first ingot and 2 grains of the second the gold was 3 times the silver; that in 2 grains of the first and 6 grains of the third the gold was 8 times the copper; that in 2 grains of the second and 3 grains of the third the silver was 5 times the copper; that in 1 grain of the first, 2 grains of the second, and 3 grains of the third the gold was 2 times the silver; that in 1 grain each of the first and second ingots there were 11 parts of gold to 5 parts of silver; and that 6 grains of the first, 5 grains of the second, and 2 grains of the third on being assayed proved to be 17 carats gold fine. There was no trace of any other metal in the ingots.

Required: The theoretical analysis of each of three ingots.

Solution by the PROPOSER.

Let x=the fraction of gold in a grain of the first ingot;
y=the fraction of silver in a grain of the first ingot;
$1-(x+y)$=the fraction of copper in a grain of the first ingot; and
z=the fraction of gold in a grain of the second ingot;
u=the fraction of silver in a grain of the second ingot;
$1-(z+u)$=the fraction of copper in a grain of the second ingot; and
v=the fraction of gold in a grain of the third ingot;
w=the fraction of silver in a grain of the third ingot;
$1-(v+w)$=the fraction of copper in a grain of the third ingot.

There are six unknown quantities and six conditions in the solution and problem which may be equated as follows: